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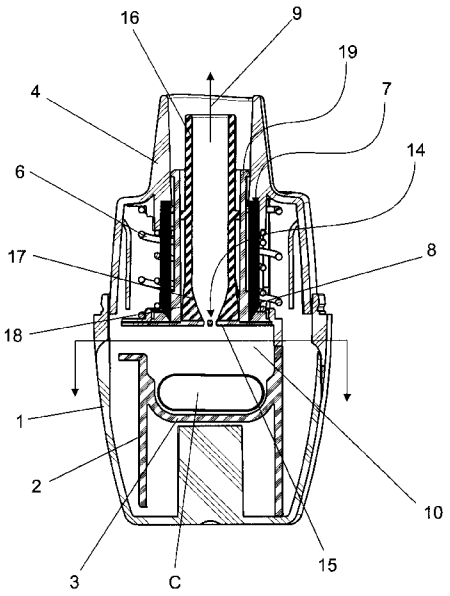


FIG. 2

(57) Abstract: Dry powder inhaler improvement, consisting of a base housing (1), snap-in capsule receptacle (2) and a moveable mouthpiece (4), this latter internally including a device (7) to open the capsule (C) containing medication in form of dry powder, housed above a deagglomeration chamber (10), with air intake points (11 and 12) and an outlet (14) for air mixed with powder, integrated with the conduit (9) of the mouthpiece (4); the above mentioned passage (14) for the air / powder mixture located between the conduit (9) and the chamber (10) is restricted and is sufficiently long to cause two effects in the capsule (C) while it spins in the chamber (10) during inhalation: a) valve - obstruction effect on the passage (14) by the capsule (C), more precisely by its cylindrical part, briefly and intermittently, with such obstruction of the passage (14) being repeated at every half turn (180°) of the capsule or whenever it is aligned with the passage (14); and b) impact of the capsule (C) through suction against the roof of the deagglomeration chamber (10) whenever it is aligned with the passage (14) and its obstruction is complete, with this impact being sufficient to neutralize the compaction of the powder at the ends of the capsule (C) during its rotation.

WO 2013/016784 A1

DRY POWDER INHALER

Field of the Invention.

This Invention addresses technical and functional enhancements introduced into an inhaler of the type developed particularly for use with inhalable powdered medications prepared in capsules containing a single dose. This device is widely used to inhale medications for the treatment of respiratory problems, where each capsule may hold a single dose or not.

State of the Art

A considerable variety of inhalers for powdered medications prepared in capsules is available, such as those addressed in the following documents:

BRPI0501263, BRPI0415711, BRPI0710078, CA2391466, DE19637125, EP0406893, EP0666085, EP0911047, EP1270034, EP1270034, EP1350532, EP2010258, PI0710078, US3906950, US3991761, US5048514, US5372128, US7284552, US7870856, WO9727892, WO2004035121, WO2004052435, WO2005044353, WO2005113042, WO2006051300, WO2007116002 and GB2151491A.

The known devices generally present their respective innovative characteristics, although in most cases these characteristics are incorporated in the basic parts, such as the compartment for inserting a single dose capsule containing powdered medication; means for perforating the capsule at two opposite points at least, means for two opposing points at least, forming small openings that form outlets for the powdered medication; structure for the air inflow created by aspiration channeling this flow to a breakdown chamber and the consequent blending thereof with the air flow; and a mouthpiece structure for inhaling the air flow with the medication.

As is apparent, the single dose capsule has practically resulted in the establishment of a standard device that allows the powdered medication to be inhaled efficiently, allowing its use for different types of treatments for respiratory problems, many of them chronic and

widespread, including asthma, bronchitis and Chronic Obstructive Pulmonary Disease (COPD). Rigid gelatin or HPMC capsules containing excipients and micronized active ingredients, either individually or in combination, are used in these inhalers.

Thus, known devices for inhaling medications in form of dry powder in capsules work with the capsules held in a receptacle as taught in, for example in documents EP1350532A2, GB2151491A and US3906950A; or loose inside a breakdown chamber with dimensions large enough to subject the capsule to specific movements, as taught for example in documents BRPI0415711A, BRPI0501263A, BRPI0710078, EP0911047A1, US5048514A, WO2004052435A1, WO2005044353A1, WO2006051300A1, WO2007116002A1, CA2391466C, EP1270034A2, US3991761A, US7284552B2, WO2005113042A1. These movements may occur with the capsule in a vertical or horizontal position.

In the vertical position, its longitudinal axis is in a vertical position and, consequently its chamber is defined by a cylindrical area with a diameter sized to hold the capsule in the vertical position, as taught in documents: BRPI0415711A, EP0911047A1, US5048514A, US3906950A, GB2151491A, WO2004052435A1, WO2005044353A1, WO2006051300A1 and WO2007116002A1

In the horizontal position, its longitudinal axis is positioned horizontally and its chamber is thus also is defined by a cylindrical area with a diameter larger than the length of the capsule in order to hold it in a horizontal position, as taught, for example, in documents: BRPI0501263A, BRPI0710078, CA2391466C, EP1270034A2, US3991761A, US7284552B2 and WO2005113042A1.

In both cases, meaning with the capsule in a vertical or horizontal position, it is subject to circular movements around its longitudinal axis, and rectilinear movements in random directions, knocking against the walls of its chamber.

On the other hand, devices with the capsule in a horizontal position, it is subject to rotation movements like a propeller.

It is noted that the movements of the capsule are an important and decisive factor for encouraging air circulation and breaking down the powder for releasing the dose during inhalation. These inhalers use different ways of opening the capsule or breaking through the wall of the capsule, or piercing the capsule at opposite points in order to allow air to flow into it and release the formulation.

Each inhaler is endowed with intrinsic physical characteristics that, together with the formulation, shape its pulmonary deposition and release profile. Dry powdered formulations prepared in capsules consist mainly of a blend of lactose and micronized active ingredients that must be broken down during inhalation in order to allow the release of the dose with an efficient percentage of fine respirable fractions, or breathable fraction (considered as particles smaller than 4.6μ micra). The respirable fraction is the percentage of the formulation reaching the lower portion of the lung, determining the efficacy of the product. For dry powder inhalers with capsules, this percentage may vary between 15% and 50%; however, the percentage values found in known registered products or in innovative products are deemed efficient and acknowledged as benchmarks references.

One of the parameters for analyzing the characteristics of a powdered medication inhaler is through its flow resistance, which determines the air volumes entering the inhaler in L/min (liters per minute). This volumetric flow may be calculated by using flow resistance at a specific inhalatory pressure in kPa (or pressure drop). The 4kPa parameter is mentioned as this is given by the European pharmacopeia and USP as the inhalatory pressure parameter (pressure drop) to be used for adjusting equipment and for in vitro analyses of formulations in powder inhalers.

In order to ensure efficient release of certain formulations, it is preferable to use inhalers that work in a stable manner

under greater inhalatory resistance (pressure drop), meaning at less than 60L/min entering the inhaler at a pressure of 4kPa.

Thus, in order to ensure efficiency for the inhaler, it should ideally present high inhalatory resistance with air flow less than 60L/min entering the inhaler at a pressure of 4kPa, which does not occur with inhalers whose capsule spins horizontally during inhalation, as exemplified in patents: BRPI0501263A, BRPI0710078, CA2391466C, EP1270034A2, US3991761A, US7284552B2 and WO2005113042A1. In addition to not allowing a flow with a desired stability, these inhalers also have the characteristic of lower inhalatory resistance, allowing an inflow of 80L/min or more into the inhaler at a pressure of 4kPa.

The preference for inhalers with greater inhalatory resistance is probably prompted by the weaker pulmonary capacity of patients affected by respiratory diseases. In these cases, is recommendable to offer inhalers that allow the dose to be released with the desired respiratory fraction, even for users with less pulmonary capacity. Considering that a healthy adult has a pulmonary capacity of 60L/min, an inhaler is desirable that can ensure air flow stability at different inhalatory flow configurations of less than 60L/min, at a pressure of 4kPa.

Dry powder inhalers that operate with the capsule inserted into a compartment or a chamber where the capsule is in vertical position , such as those described in patents: BRPI0415711A, EP0911047A1, US5048514A, GB2151491A, WO2004052435A1, WO2005044353A1, WO2006051300A1 and WO2007116002A1 and US3906950A, are generally designed to operate with greater inhalatory resistance, although their individual construction characteristics may present differences of efficiency in releasing the dose and resulting lung deposition profile.

The formulation release profile of the capsule compartment is also influenced by the manner and site where the capsule is opened. Normally, dry powder inhalers use needles or pins to pierce the

capsule at its ends. This is designed to ensure that the air flow also penetrates the capsule through a vortex, encouraging the creation of the spray in the deagglomeration or breakdown chamber housing of the capsule, resulting in a mixture of the air with the inhalant substance that flows through the mouth piece, and from there to the lungs.

Some dry powder inhalers with greater inhalatory resistance, such as for example, those described in documents WO2005/044353 and WO2004/052435A1, have the capsule perforated on the side, and work with the capsule in a vertical position, presenting a lung deposition profile differing from those that work with the capsule in a horizontal position and with less inhalatory resistance.

Purpose of the Invention.

Technical and functional improvements in order to comply with certain lung deposition profiles and performance stability with high resistance for inhalers delivering medication in dry powder prepared in capsules, where the capsule is housed horizontally in the inhaler, being subject to a variety of movements, adequately breaking down the particles of the medication and forming an air and powder mixture with a stable flow in distinct inhalatory flows of less than 60L/min at a pressure of 4kPa. Another purpose of the invention is to provide means to allow the capsule itself to serve a real air flow valve and concomitantly, this effect also causes repetitive impacts of the capsule against the walls of its chamber in order to improve the outflow of the powder and its deagglomeration, in order to achieve a specific percentages of fine repirable or breathable fraction (particles smaller than 4.6μ micra), which would enhance the efficacy of the medication or even bring its level of efficacy up to specific benchmark standards.

In order to achieve these purposes, the inhaler has been improved in its air / powder mixture chamber, more specifically at the air flow outlet and, in order to do so, a passage was introduced in the roof of this chamber with specific geometry, carefully dimensioned, normally rectangular,

which constitutes an outlet for the inhalant, with the length of this outlet also being preferably equal or less to the length of the cylindrical part of the capsule (except rims) and its width is approximately 1/3 or less than its diameter. Logically, this opening is fitted with a sieve at an appropriate mesh, in order to retain possible particles whose dimensions are not appropriate for inhalation. Thus, during the inhalation process, the capsule is subject to a variety of rotating and rectilinear movements in the vertical or horizontal positions, consequently leading to the affirmation that, as the air flow enters the inhaler, the capsule rotates horizontally like a propeller and is concomitantly moved outwards and downwards, hitting the bottom and roof of its chamber. When it is up against the roof, a specific effect occurs, because as a given movement, the capsule and the outlet are aligned, thus producing a valve-like effect, meaning that the capsule is practically sucked in to the rectangular outlet and at this time the airflow is reduced for just a fraction of a second, due to the rotation of the capsule, thus defining a new standard of functioning through which the air outlet from the capsule chamber is blocked intermittently during inhalation. These sudden blockages in fact generate additional forces with micro-collisions of the capsules against the inner walls of the chamber, producing other effects that cause the powder in the capsule to be subject to bursts that move the clumped powder in directions opposite to the centrifugal and gravitational forces at its ends, fostering deagglomeration and release with greater efficiency normally achieved merely through a vortex effect inside the chamber. In this case, the brief intermittent blockages of air occur when the displacement of the capsule in the air flow forces it up against the air outlet from the chamber, with both longitudinal axes aligned.

This improvement is presented in an alternative form for the release of inhalable powdered formulations with a more efficient pulmonary deposition profile for an inhaler that functions with the capsule in a horizontal position.

This invention describes an improvement in

construction for a version of a powder inhaler that functions with a capsule subject to a horizontal rotating movement, which offers an efficient powder release profile with high inhalatory resistance, in contrast to the standard model for dry powder inhalers that work with the capsule in a horizontal position and with lower inhalatory pressure.

Description of the drawings.

For better understanding of this invention, a detailed description thereof is presented below, referring to the appended drawings:

FIGURE 1 represents an isometric view showing the inhaler with the cap exploded and the capsule receptacle in position in order to receive the capsule;

FIGURE 2 shows a view in elevation presenting the inhaler in cross section;

FIGURE 3 illustrates the cross section view indicated in the previous FIGURE, highlighting the construction details of the breakdown chamber;

FIGURE 4 is another view in elevation showing the inhaler in cross section; however, in this view the device is in the action position for perforating the ends of the capsule;

FIGURE 5 displays a set of views illustrating the functioning of the equipment as a whole;

FIGURES 6 and 7 reproduce the cross sections indicated therein, showing details of the flow guide tube;

FIGURES 8 and 9 are respectively a perspective and a lower view highlighting the restrictive passage of the flow guide tube with the sieve-like structure;

FIGURE 10 shows in diagram form the behavior of the capsule during the functioning of the known device;

FIGURE 11 represents a diagram view of the behavior of the capsule in the inhaler, according to this invention;

FIGURES 12 and 13 show cross sections, highlighting a specific characteristic of the flow guide tube, whose upper end serves as an indicator of when the capsule is perforated, in order to form radial openings around its ends;

FIGURE 14 illustrates a view in cross section and two enlarged details, highlighting the construction of the primary intake point for the inhalation air flow;

FIGURES 15 and 16 show, respectively, a side view and a cross section, highlighting an alternative type of construction for the primary intake point of the inhalation air flow;

FIGURES 17 and 18 display cross sections highlighting an optional construction or the flow guide tube with a rim at its upper end;

FIGURE 19 reproduces a view in cross section showing a dimensional characteristic of the breakdown chamber; and

FIGURES 20 and 21 show, respectively, a front view and an isometric view, highlighting an optional characteristic for the construction of the inhaler, making previsions for transparent parts that allow an inside view to ensure the correct positioning of the capsule before it is opened or perforated.

Detailed description of the invention.

In compliance with these illustrations and their details, more specifically FIGURES 1 to 4, this Invention of **DRY POWDER INHALER IMPROVEMENT** is applicable to a type that has been developed especially for use solely with inhalable medications in form of dry powder prepared in capsules containing a single dose, such as that taught in documents WO2007/098870 (BRPI0710078), consisting of:

- base housing (1) with a cross section that is normally oval and completely hollow;

- a snap-in capsule receptacle (2) affixed in an

articulated manner to the inner portion of the lower half of the base housing (1) and with sufficient means to be pivoted outwards and expose its slot-in cradle (3) capsule housing (C) containing powdered inhalant medication, and means for such capsule receptacle to return to the initial position aligned with the longitudinal axis of the base housing (1);

- a moveable mouthpiece (4) affixed on the upper part of the base housing (1), with this mouthpiece having a cap on the outside (5), while on the inside it can also be connected to the base housing, and also has the means to be moved vertically downwards or outwards including a helical spring (6), that functions in cooperation, allowing this mouthpiece to run vertically downwards and upwards, with the former responding to manual pressure that exceeds the strength of the spring (6), and the return movement upwards is due to the force of this helical spring (6);

- a device (7) for opening the capsule (C), firmly affixed to the inner side of the mouthpiece (4), which device, in addition to being moved together with the mouthpiece (4), also has means consisting of a pair of vertical needles (8) whose lower sharp points are positioned to radially perforate the lateral ends portions of the capsule (C) forming small openings (S) for the outflow of the powdered medication; and

The above mentioned mouthpiece (4) also has means to establish an inward air flow from outside and is hollow in order to do so, forming a vertical passage (9) for the inhalant, whose lower end is connected to the capsule receptacle (2) which, above the slot-in cradle (3), has a wider portion that constitutes the deagglomeration chamber (10), cylindrical, with a diameter slightly larger than the length of the capsule (C), and also has a tangential secondary air intake point (11) positioned between the walls of the capsule receptacle (2) and the base housing (1) which in turn has one or two primary air intake points (12), with a pocket forming between them (13) which improves the stability of the air flow created when the patient breathes in during the inhalation process.

In FIGURE 5, it may be noted that the inhalation process begins when the snap-in capsule receptacle (2) is packed with a capsule (C) containing powdered medication. The capsule (C) slots smoothly into the cradle (3), avoiding movement. When the capsule receptacle (2) is snapped back into its original position (closed), the capsule remains in a stable position so that the opening device (7) can be brought into action by pressing the mouthpiece (4) through its surrounding shoulder, while the needles (8) move downwards and radially perforate the ends of the capsule (C), forming openings (S) for the outflow of the powdered medication, which occurs only when the user breaths in through the mouthpiece. Such inhalation results in an airflow that runs through the primary intake point (12), the air pocket (13) and the secondary intake point (11) tangentially reaching the interior of the breakdown chamber (10), where the vortex effect causes an outflow from the capsule (C) in its cradle,(3) at which time it starts to spin and, due to the restrictions of the chamber (10), during this spinning movement it nevertheless remains in a horizontal position. The capsule movements allow the outflow of the powder that it holds, allowing the air/powder mixture to be formed by the vortex in the chamber (10), which can flow out along the conduit (9) and reach the lungs of the user.

FIGURE 10 shows in a diagram the behavior of the capsule (C) in a known device where (F) is the air flow and (T) is the outlet passage to the air / powder mixture. In this Figure, it is clear that centrifugal force (G) moves the powder towards the outlets at the ends of the capsules (C) and openings (S) that speed up its dispersal in the air flow, while also producing an undesirable effect, as this tends to compact the powdered medication at the ends of the capsule (C). Although not marked, this compaction does not allow the desired breakdown of the medication in order to obtain the necessary fine breathable fraction (percentage of particles smaller than 4.6μ micra), with negative effects on the efficacy of the inhaled medication; however, this situation is eliminated with this improvement.

This invention, **DRY POWDER INHALER IMPROVEMENT**, as illustrated in Figures 5 to 9, is characterized by the fact that the passage (14) for the air / powder mixture located between the conduit (9) and the chamber (10) is restricted and has a geometry that is long enough to cause both effects on the capsule (C) while it spins in the chamber (10) during inhalation:

a) intermittent block valve – obstruction of the passage (14) by the capsule (C), more precisely by its cylindrical part, briefly and intermittently, with such obstruction of the passage (14) being repeated at every half turn (180) of the capsule or when it is aligned with the passage (14); and

b) breakdown of the powder in the capsule (C) during its impact against the roof of the breakdown chamber (10), which occurs through suction whenever the capsule (C) is aligned with the passage (14).

The passage (14) is normally rectangular.

The dimensions of the passage (14) are proportional to the dimensions of the capsule (C), with the length of this being preferably smaller than or equal to the length of the cylindrical part of the capsule (C), while the width is around 1/3 or less than the diameter of the capsule (C).

The passage (14) includes a sieve-like structure (15) for trapping any fragments that might be inhaled, such as those from the capsule itself.

In a preferred construction, the passage (14) is configured at the lower end of the flow guide tube (16), centralized and housed on the inner side of the mouthpiece (4), where its upper end fits into this mouthpiece (4), while its lower end narrows inwards (17) and outwards (18), internally and externally, helping form the passage (14) positioned above the sieve-like structure (15) which, in turn, constitutes the roof of the deagglomeration chamber (10).

In order to avoid a false air intake point, the external diameter or size of the flow guide tube (16) must fit tightly against the inner side of the vertical neck (19) that, in addition to forming an integral part for being firmly affixed to the mouthpiece structure (4) and base (1), also presents external details that serve as a runner guiding the vertical movement of the mouthpiece (4) and its piercing device (7).

With the improvement in question, a preparation of the inhaler, illustrated in FIGURE 5, is the same as that described previously, while the air flow entering this device follows the same path and, once in the breakdown chamber (10), the capsule (C) spins in a horizontal position, meaning its longitudinal axis is in a horizontal position. This rotation causes centrifugal acceleration in the powdered medication that it contains and consequently it moves towards the end of the capsule towards the openings (S) pierced by the needles, (8), where the air flow of these openings produce an effect similar to the venturi effect, meaning that the powder consequently leaves the capsule and blends with the air, moving out through the passage (14) and the longer conduit (9) in order to progress to the lungs of the user.

FIGURE 11 presents a diagram showing the behavior of the capsule (C) with the improvement in question, through which it may ascertained that when the capsule, due to the movement generated by the air vortex in the chamber (10) moves along the passage (14), it alters the behavior of the capsule (C), which is spinning horizontally, meaning along its longitudinal axis (E) in a horizontal position. This rotation means that, at a specific moment (Figures 7 and 8) the capsule is longitudinally aligned with the longitudinal axis of the passage (14). This alignment triggers a sequence of effects, through which the capsule is first sucked against the passage (14), serving as a temporary block valve, although for a very brief period of time. When this alignment is complete, another effect occurs, which is the sharp impact of the capsule against the roof of the deagglomeration chamber (10). These events take place on each half turn for an 180° spin of the capsule (C).

It may thus be said that the impact event is intermittently repetitive, as long as the air flow continues. Each impact of the capsule against the roof of the deagglomeration chamber (10) causes a breakdown effect on the powder that it contains, meaning that the powder moves randomly due to other opposing forces (X), avoiding any compaction at the ends of the capsule and consequently, significantly improving its breakdown and a percentage of fine respirable fraction (particles smaller than 4.6μ micra), thus enhancing the efficacy of the medication release profile.

Shown in Figures 12 and 13, the flow guide tube (16) presents sufficient height (H) in order to comply with two conditions: a) its upper end is built in under the side of the mouthpiece (4) in compliance with a specific elevation level (C^1) when the above mentioned mouthpiece (4) is in the usage position, and b) its upper end is slightly exposed, in compliance with a specific elevation level (C^2) when the mouthpiece (4) which at its lowest position when perforating the capsule (C), with this exposed section constituting an indicator that the capsule (C) has been perforated (opened).

FIGURE 14 shows another characteristic of this improvement because as already mentioned, in order for the inhaler to reach ideal efficiency, it must present high inhalatory resistance with stable air flow below 60L/min entering the inhaler at a pressure of 4kPa. In order to achieve these characteristics, the breakdown chamber (10) must have an adequate combination of dimensions between the intake point (11) and the outlet (14); however, another important factor is the existence of an air balloon (13) with a volume larger than that of the deagglomeration chamber (10), always positioned between the secondary intake point (11) and the primary intake points (12), with the latter being positioned for this purpose preferably on lower wall and below the mouthpiece shoulder (4), just as the each secondary air intake point (12) also has a supplementary deflector wall (20), positioned in parallel to the inner side.

In another preferred construction illustrated in

Figures 15 and 16, at least one primary intake point (12) makes provision for a side wall of the base housing (1), stating that this wall (20), might or might not be supplementary, and offers almost the same desired effect.

In terms of Figures 17 and 18, an alternative preferred construction, the flow guide tube (16) has a truncated-cone rim (21) that opens and slides along the inner diameter of the moveable mouthpiece (4) closing the space between these parts, with this truncated-cone rim also being positioned below the upper end of the flow guide tube (16), at sufficient distance to ensure that it always remains on the inner side of the mouthpiece (4), even when this is pressed downwards to perforate or open the capsule (C), as shown in Figure 18, keeping the exposed tip in compliance with a specific elevation level (C^1). This alternative is designed to avoid a whirlpool effect in the air flow when the medication mixture flows through the upper part of the tube (16) into the mouthpiece (4) and to the mouth and lungs of the user.

With regards to Figure 19, in a preferred construction, a tangential secondary air intake point (11) moves downwards from the roof of the deagglomeration chamber (10) or the plan defined by the passage (14) or up to a height defined by the elevation level (B) which corresponds to preferentially one half or less of the diameter of the capsule (C) and a total height (H) slightly larger than the diameter of the above mentioned capsule (C).

As illustrated in Figures 20 and 21, in another preferred construction, transparent means are addressed (22) in the capsule receptacle (2) and its outer wall (23) that are sufficient to see the capsule (C) before it is perforated or opened.

These viewing points are efficient enough to check whether the capsule (C) is correctly positioned in the cradle (3) before it is opened or perforated as, in some other position, although unlikely to occur, and should such irregular event occur, this is also indicated by the device, as

the upper end (elevation level C^2) of the tube (16) does not remain exposed, indicating an irregularity in the opening or perforation of the capsule (C) with this irregular event also possibly resulting in the undesired crumpling of the capsule (C).

The transparent means are defined preferably by a window (24) in the outer wall of the capsule receptacle (2) which in turn has at least its deagglomeration chamber (10) including the cradle (3) made from transparent material.

Also, the transparent parts confer ideal means that ensure a clear view for ascertaining the correct positioning of the capsule (C) before it is opened or perforated and, if this occurs, the upper end (elevation level C^2) of the tube (16) is exposed, confirming that the operation was completed correctly.

The improvement in question complies with the purposes mentioned above, offering alternative form for ensuring the efficacious release of inhalable powdered formulations through an inhaler using capsules with high inhalatory resistance and with the capsule functioning in a horizontal rotating position. This also presents a more stable air flow during inhalation, and the means for achieving a specific pulmonary deposition profile, due not only to the presence of the flow guide tube (16) and the respective restricted passage (14), but also through the flow stabilizer area (13) and the secondary intake points (11) and the principal intake points (12), with the combination of these details culminating in substantially more efficient functioning, providing high inhalatory resistance with uniform airflows at less than 60L/min at a pressure of 4kPa; consequently, this improved inhaler meets its main purpose, which is an adequate breakdown of micronized active ingredients during inhalation, allowing the release of an efficient percentage of fine respirable fraction, (particles smaller than 4.6µ micra) under these inhalatory flow conditions.

CLAIMS

1) **DRY POWDER INHALER IMPROVEMENT**, consisting of:

- base housing (1) with cross section that is usually oval and completely hollow;

- a snap-in capsule receptacle (2) affixed with articulation inside the base housing (1) and with sufficient means to be positioned at an upwards slant, exposing its slot-in cradle (3) capsule housing (C) containing powdered inhalant medication, and the means for such capsule receptacle to return to the initial position aligned with the longitudinal axis of the base housing (1);

- a moveable mouthpiece (4) affixed on the upper part of the base housing (1), with this mouthpiece fitted with a cap on the outside (5), while in the inside it also has the means to be connected to the base housing, and it also has the means to be moved vertically downwards or upwards, including a helical spring (6), which work together in order to allow this mouthpiece to be moved vertically downwards and upwards, with the former through manual pressure pushing down against the force of the spring (6), and the return movement upwards driven by the force of this helical spring (6);

- a device (7) for opening the capsule (C), firmly affixed to the inner side of the mouthpiece (4), which device, in addition to being moved together with the mouthpiece (4), also has means consisting of a pair of vertical needles (8) whose lower sharp points are positioned to radially perforate the ends of the capsule (C) forming small openings (S) for the outflow of the powdered medication; and

- the above mentioned mouthpiece (4) also has means to establish an outside-inwards air flow and is hollow in order to do so, forming a passage (9) for the inhalant, whose lower end is connected to the capsule receptacle (2) which, above the slot-in cradle (3), has a wider portion that constitutes a degglomeration chamber (10), cylindrical, with a diameter slightly larger than the length of the capsule (C), and also has a tangential secondary air intake point (11) positioned between the walls of the capsule receptacle (2) and the

base housing (1) which in turn has one or two primary air intake points (12), with a pocket forming between them (13);

characterized by the fact that the passage (14) for the air / powder mixture located between the conduit (9) and the chamber (10) is restricted and has a geometry that is long enough to cause both effects on the capsule (C) while it spins in the chamber (10) during the inhalation process:

a) intermittent block valve – obstruction of the passage (14) by the capsule (C), more precisely by its cylindrical part, briefly and intermittently, with such obstruction of the passage (14) being repeated at every half turn (180) of the capsule or when it is aligned with the passage (14); and

b) degglomeration of the powder in the capsule (C) during its impact against the roof of the chamber (10), which occurs through suction whenever the capsule (C) is aligned with the passage (14).

2) **DRY POWDER INHALER IMPROVEMENT**, as set forth in Claim 1, characterized by the fact that, in a preferred construction, the passage (14) is usually rectangular in shape.

3) **DRY POWDER INHALER IMPROVEMENT**, as set forth in Claim 1, characterized by the fact that, in a preferred construction, the passage (14) presents dimensions proportional to the dimensions of the capsule (C), with a length equal or less the length of the cylindrical part of the capsule (C), while the width is equal to around 1/3 or less of the diameter of the capsule (C).

4) **DRY POWDER INHALER IMPROVEMENT**, as set forth in Claim 1, characterized by the fact that, in a preferred construction, the passage (14) includes a sieve-like structure (15) as a fragment trapper.

5) **DRY POWDER INHALER IMPROVEMENT**, as set forth in Claim 1, characterized by the fact that, in a preferred construction, the passage (14) consists at the lower end of a flow guide tube (16), centralized and housed on the inside of the mouthpiece (4), where its upper end terminates in the mouthpiece (4), while the lower end narrows inwards (17) and outwards (18), internally and externally, helping form the passage (14) positioned over the

sieve-like structure (15), which in turn constitutes the roof of the deagglomeration chamber (10).

6) **DRY POWDER INHALER IMPROVEMENT**, as set forth in Claim 1, characterized by the fact that in order to avoid a false air intake point, the flow guide tube (16) presents its side or external diameter fitting tightly against the inner side of a vertical throat (19) which, in addition to forming an integral part thereof or being solidly connected to the mouthpiece (4) structure of the base (1), also presents external details consisting of a runner guiding the vertical movement of the mouthpiece (4) and its perforation device (7).

7) **DRY POWDER INHALER IMPROVEMENT**, as set forth in Claim 5, characterized by the fact that, in a preferred construction, the flow guide tube (16) presents a height (H) sufficient to comply with two conditions: a) its upper end fits into the inside of the mouthpiece (4) in compliance with an elevation level (C^1) when the above mentioned mouthpiece (4) is in its position for use and b) its upper end is slightly exposed in compliance with an elevation level (C^2) when the mouthpiece (4) reaches its lowest position during the perforation of the capsule (C), with the exposed segment constituting an indicator that the capsule (C) has been perforated (opened).

8) **DRY POWDER INHALER IMPROVEMENT**, as set forth in Claim 1, characterized by the fact that at least one primary intake point (12) is positioned in a manner whereby between it and at least one secondary point (11) the air balloon is positioned (13).

9) **DRY POWDER INHALER IMPROVEMENT**, as set forth in Claim 8, characterized by the fact that at least one primary intake point (12) is positioned preferably in the lower wall and below the mouthpiece shoulder (4).

10) **DRY POWDER INHALER IMPROVEMENT**, as set forth in Claim 1, characterized by the fact that each secondary air intake point (12) is fitted with a supplement of a deflector wall (20), positioned parallel to the inner side.

11) **DRY POWDER INHALER IMPROVEMENT**, as set forth in Claim 8,

characterized by the fact that, in another preferred construction, at least one primary intake point (12) is located on the side wall of the base housing (1), with or without the supplementary wall (20).

12) **DRY POWDER INHALER IMPROVEMENT**, as set forth in Claim 1, characterized by the fact that, in an alternative preferred construction, the flow guide tube (16) has its external diameter fitted with a closing device consisting of a truncated-cone rim (21) that closes and slips into the inner diameter of the moveable mouthpiece (4), closing the space between these items.

13) **DRY POWDER INHALER IMPROVEMENT**, as set forth in Claim 12, characterized by the fact that this truncated-cone rim is positioned below the upper end of the above mentioned flow guide tube (16) and at a distance sufficient to keep it always inside the mouthpiece (4), including when the latter is pressed downwards in order to perforate or open the capsule (C).

14) **DRY POWDER INHALER IMPROVEMENT**, as set forth in Claim 1, characterized by the fact that, in a preferred construction, a tangential secondary air intake point (11) functions in a downwards manner, starting at the roof of the breakdown chamber (10) or the level defined by the passage (14) up to a height defined by the elevation level (B) which corresponds to one half or less of the diameter of the capsule (C) and a total height (H) that is slightly larger than the diameter of the above mentioned capsule (C).

15) **DRY POWDER INHALER IMPROVEMENT**, as set forth in Claim 1, characterized by the fact that, in another preferred construction, transparent means are provided (22) in the capsule receptacle (2) and its outer wall (23) that are sufficient to see the capsule (C) before it is perforated or opened.

16) **DRY POWDER INHALER IMPROVEMENT**, as set forth in Claim 14, characterized by the fact that the transparent means are defined preferably by a window (24) in the outer wall (23) of the capsule receptacle (2) which in turn has at least its chamber (10), including the cradle (3) made from transparent material.

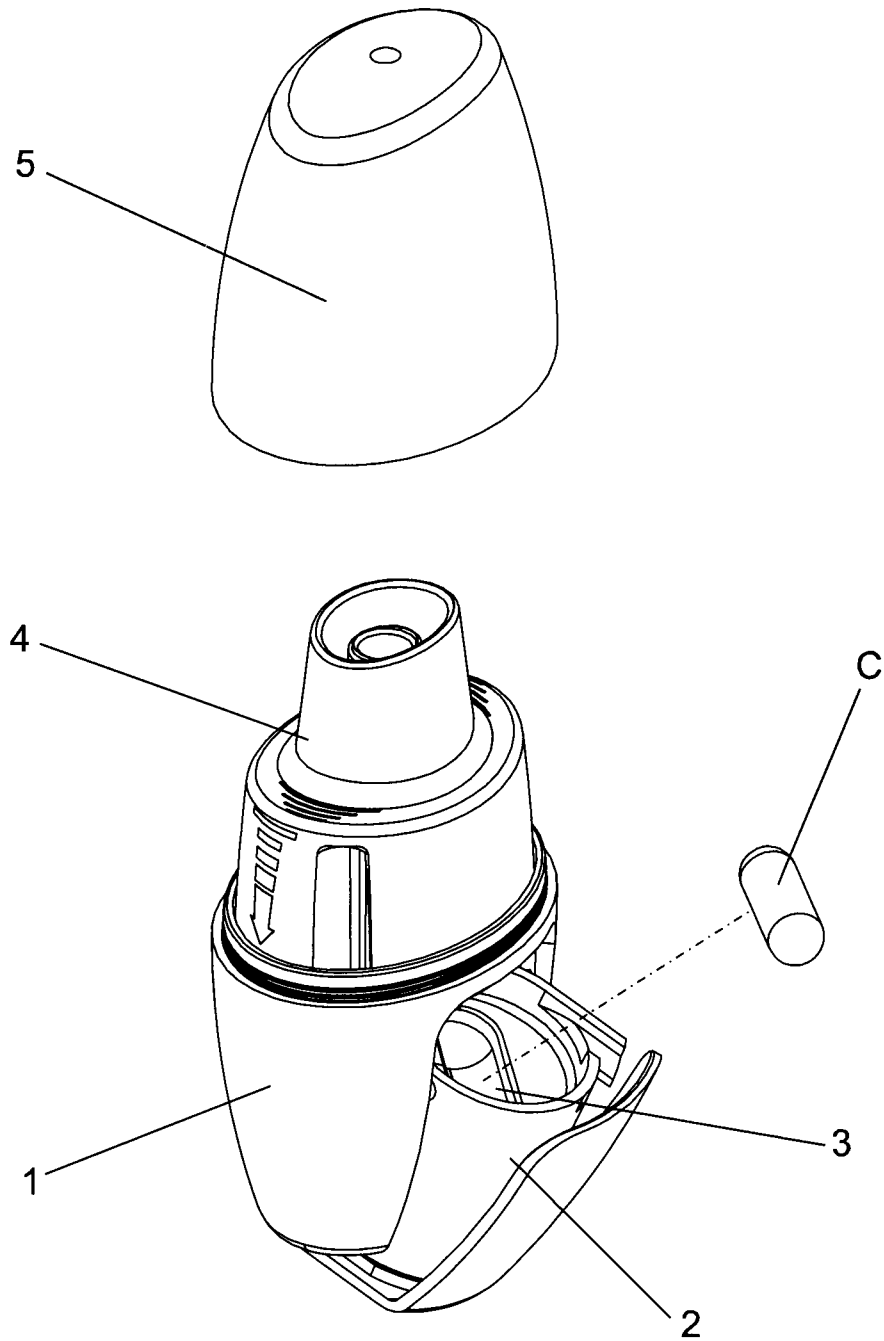


FIG. 1

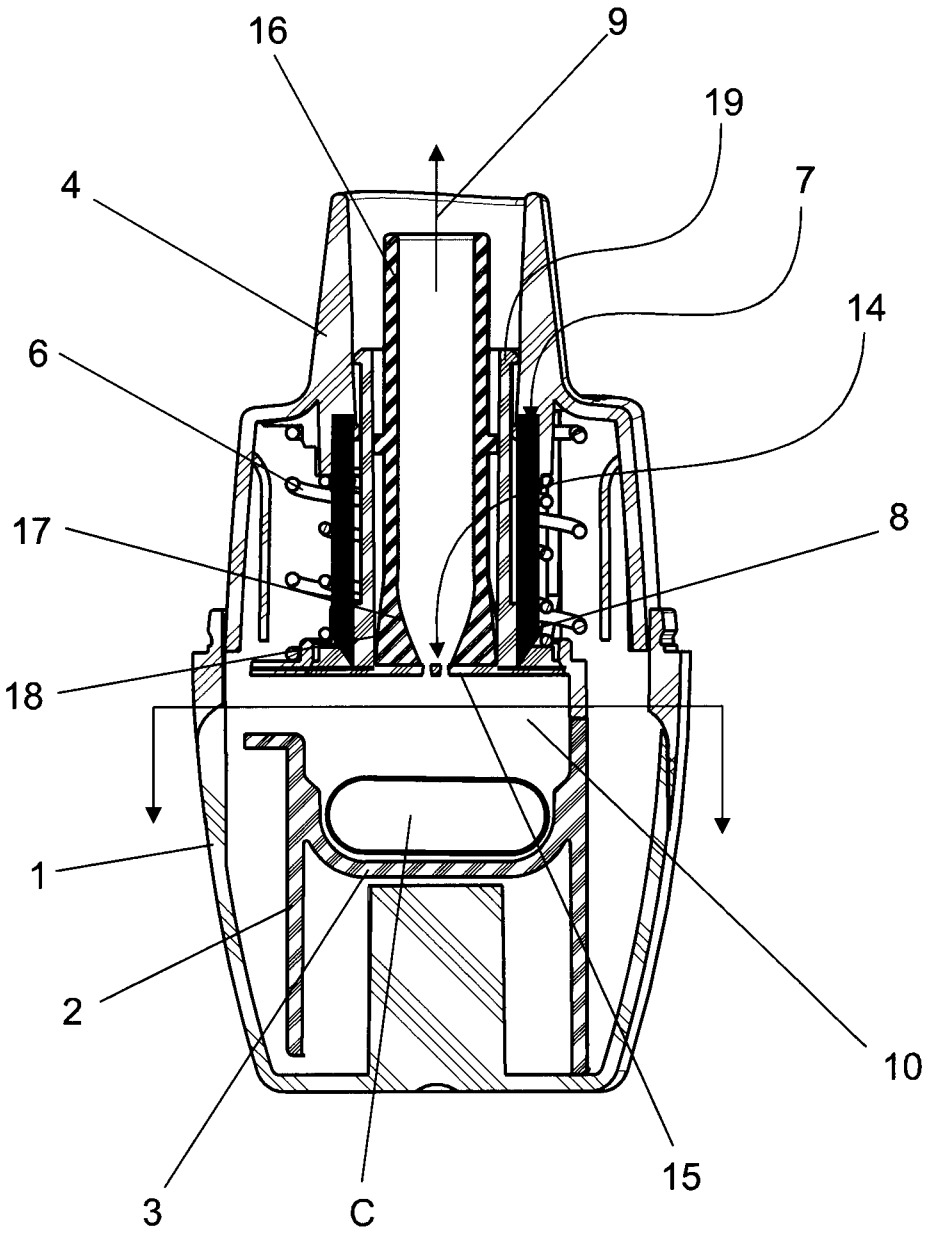


FIG. 2

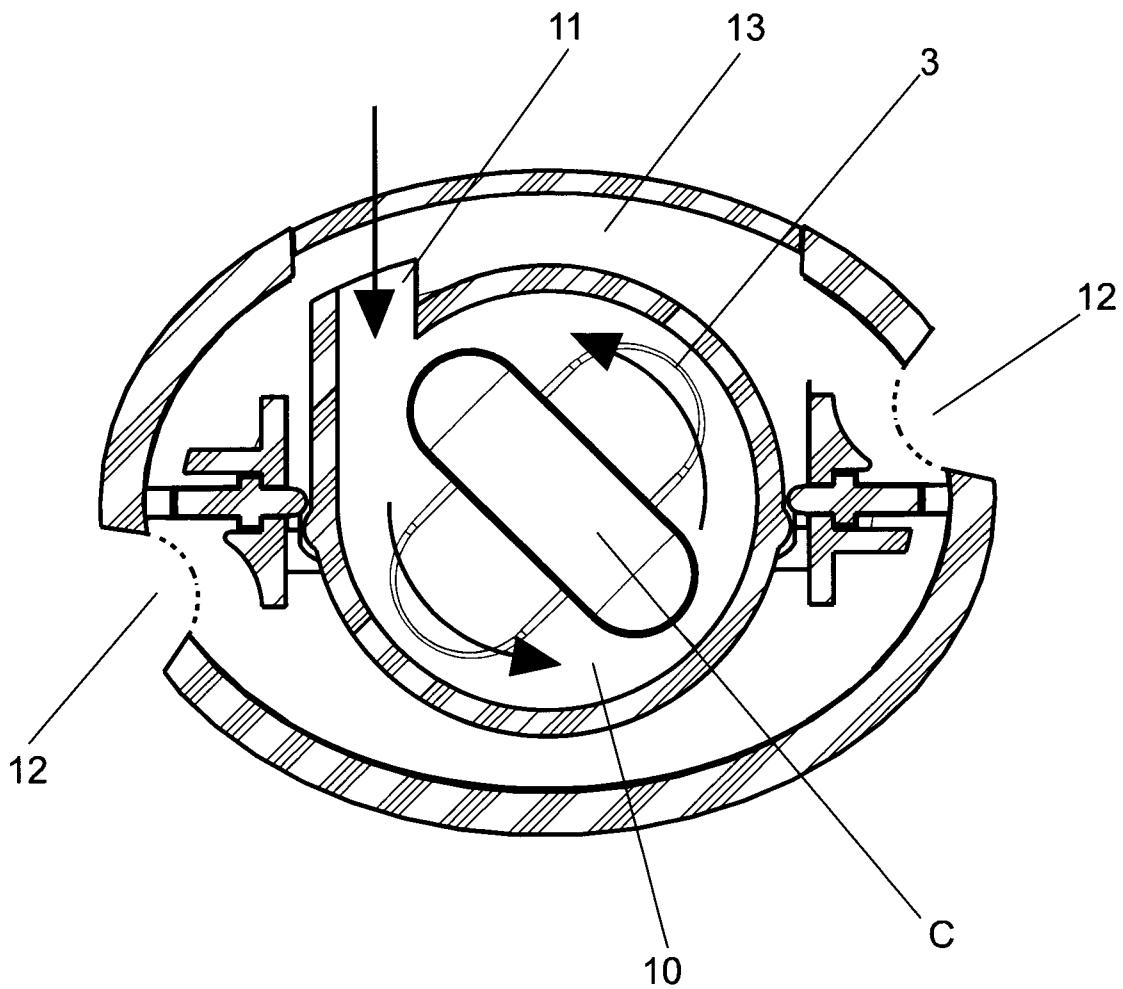


FIG. 3

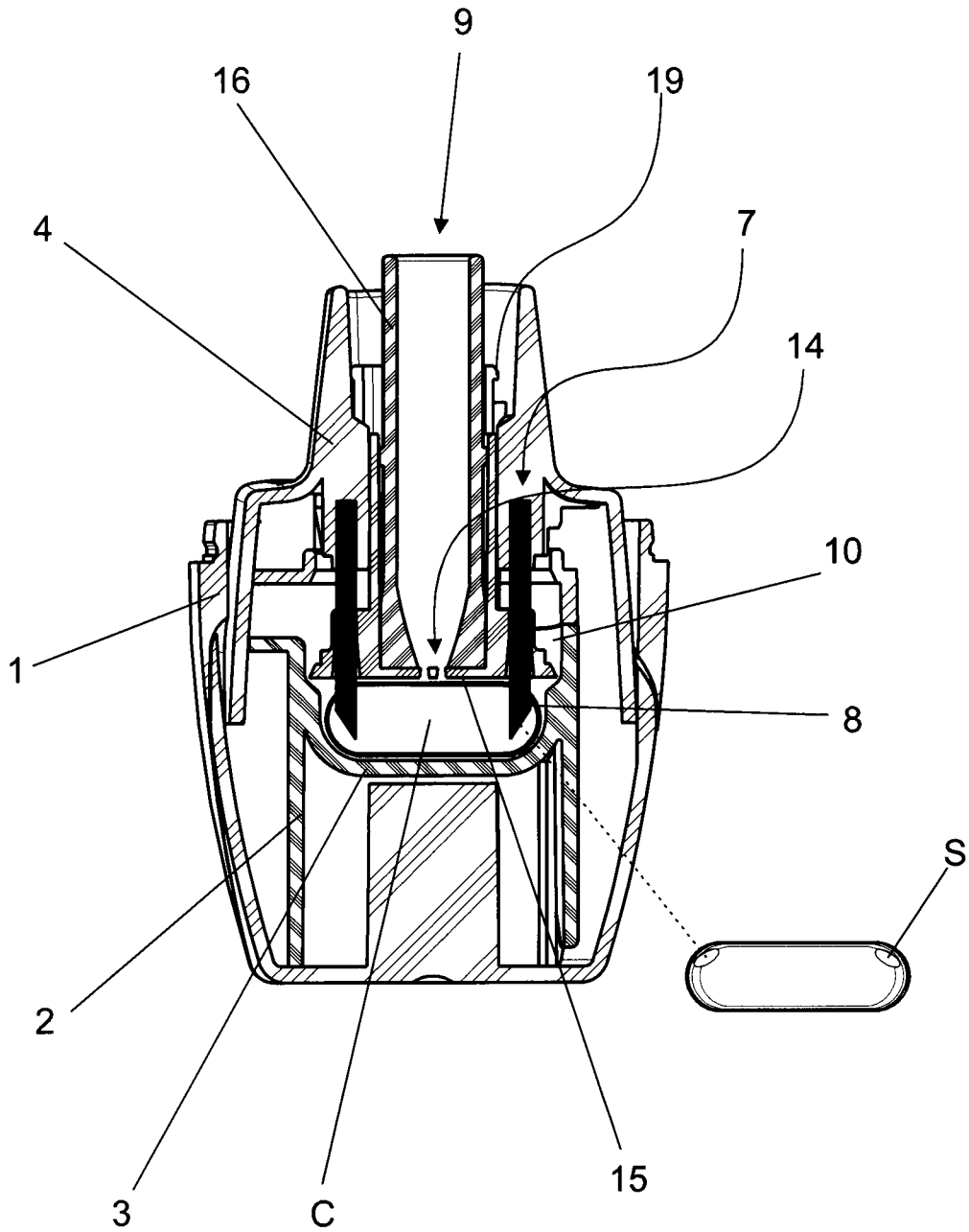


FIG. 4

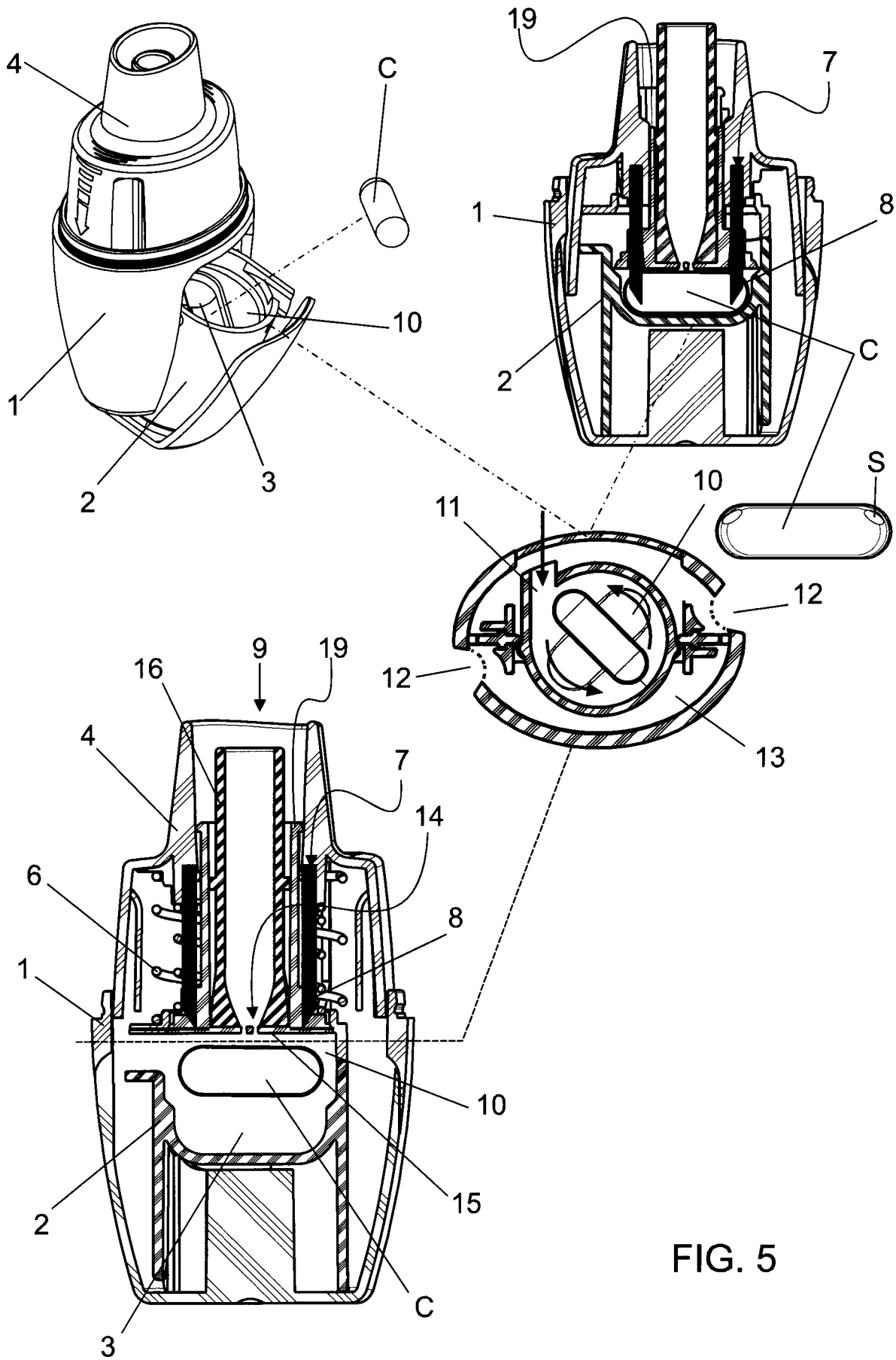


FIG. 5

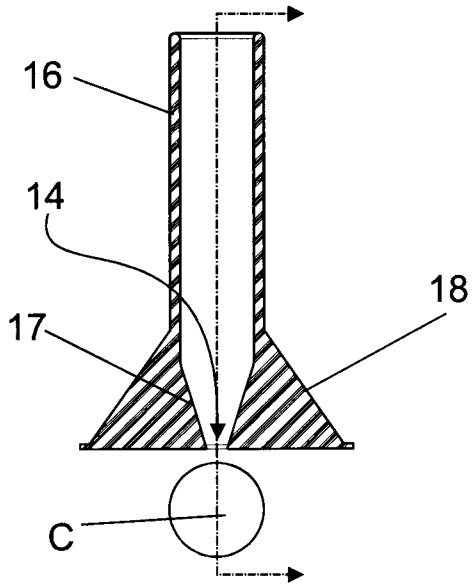


FIG. 6

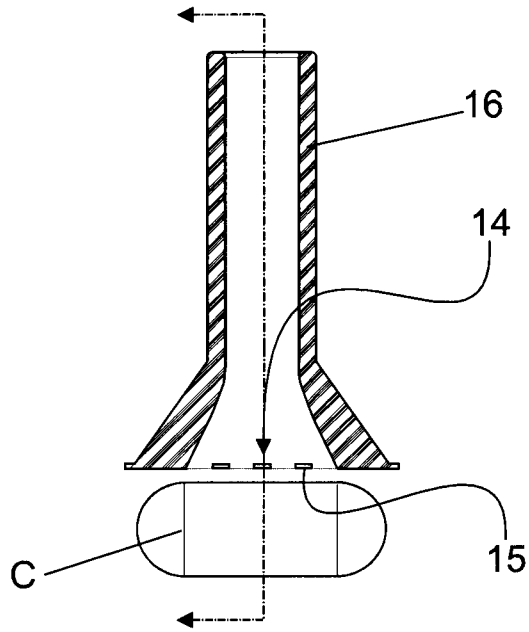


FIG. 7

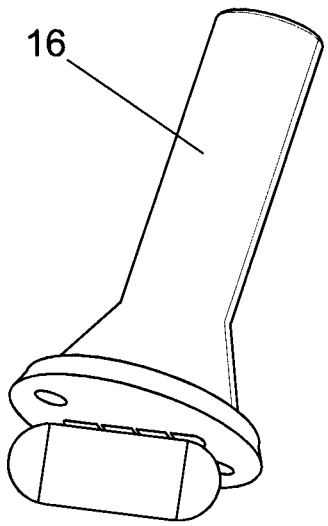


FIG. 8

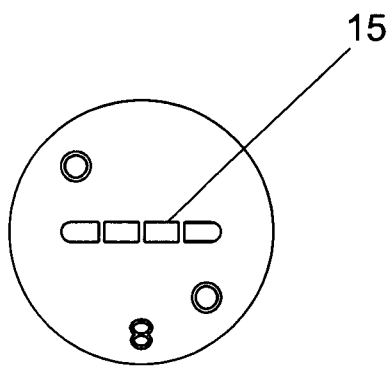


FIG. 9

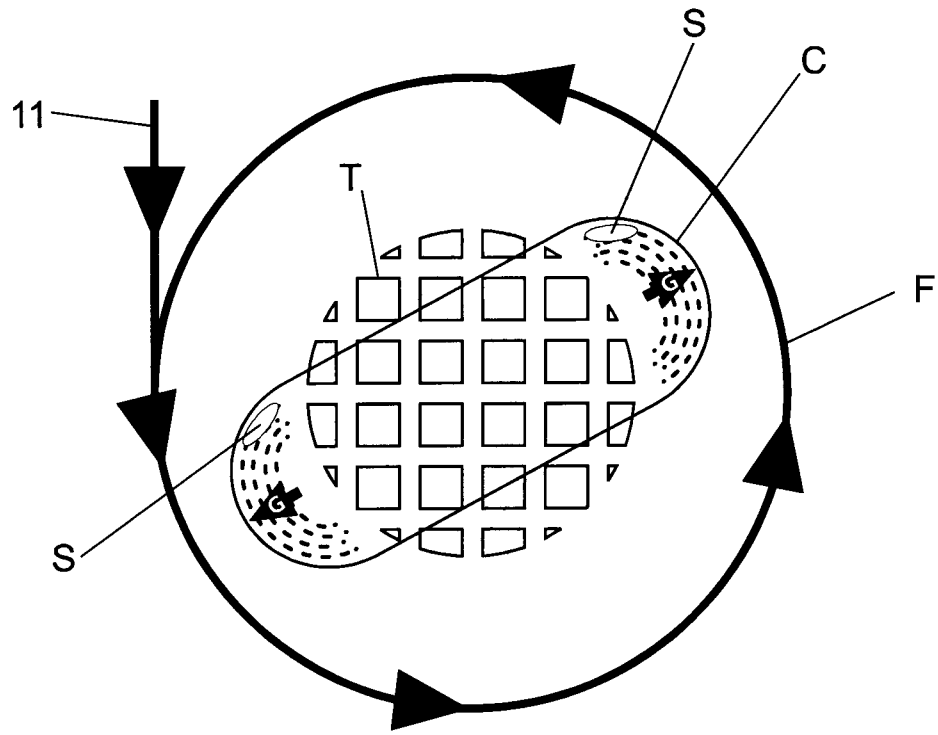


FIG. 10

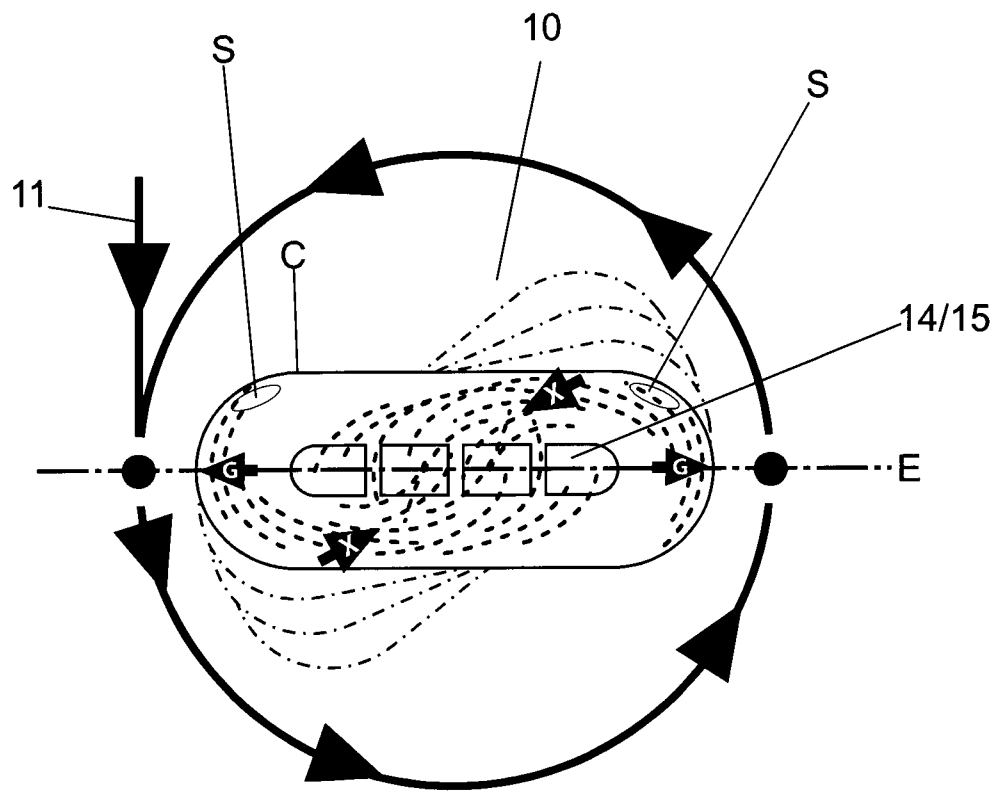


FIG. 11

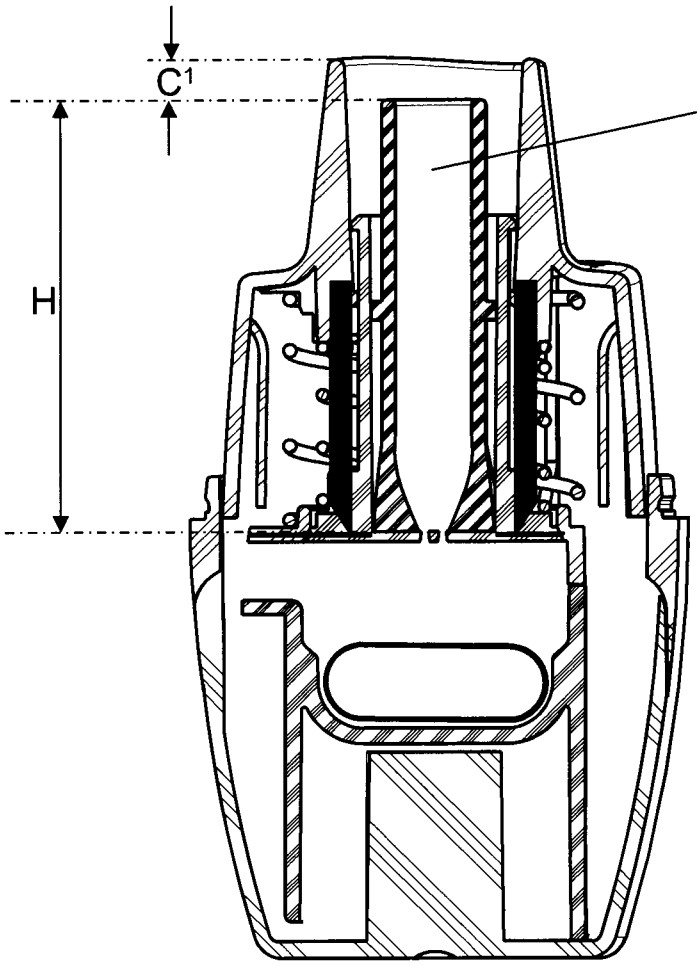


FIG. 12

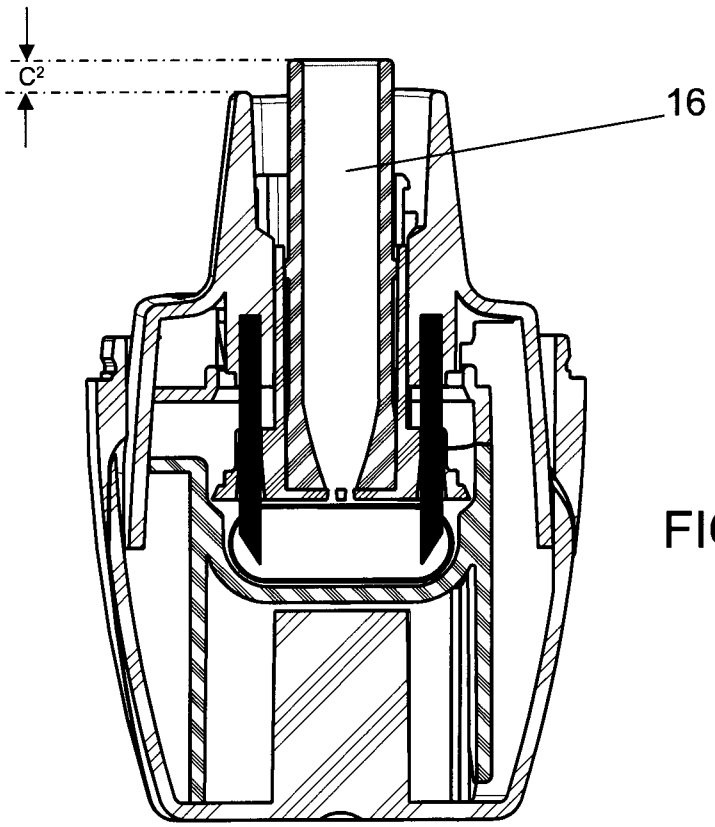


FIG. 13

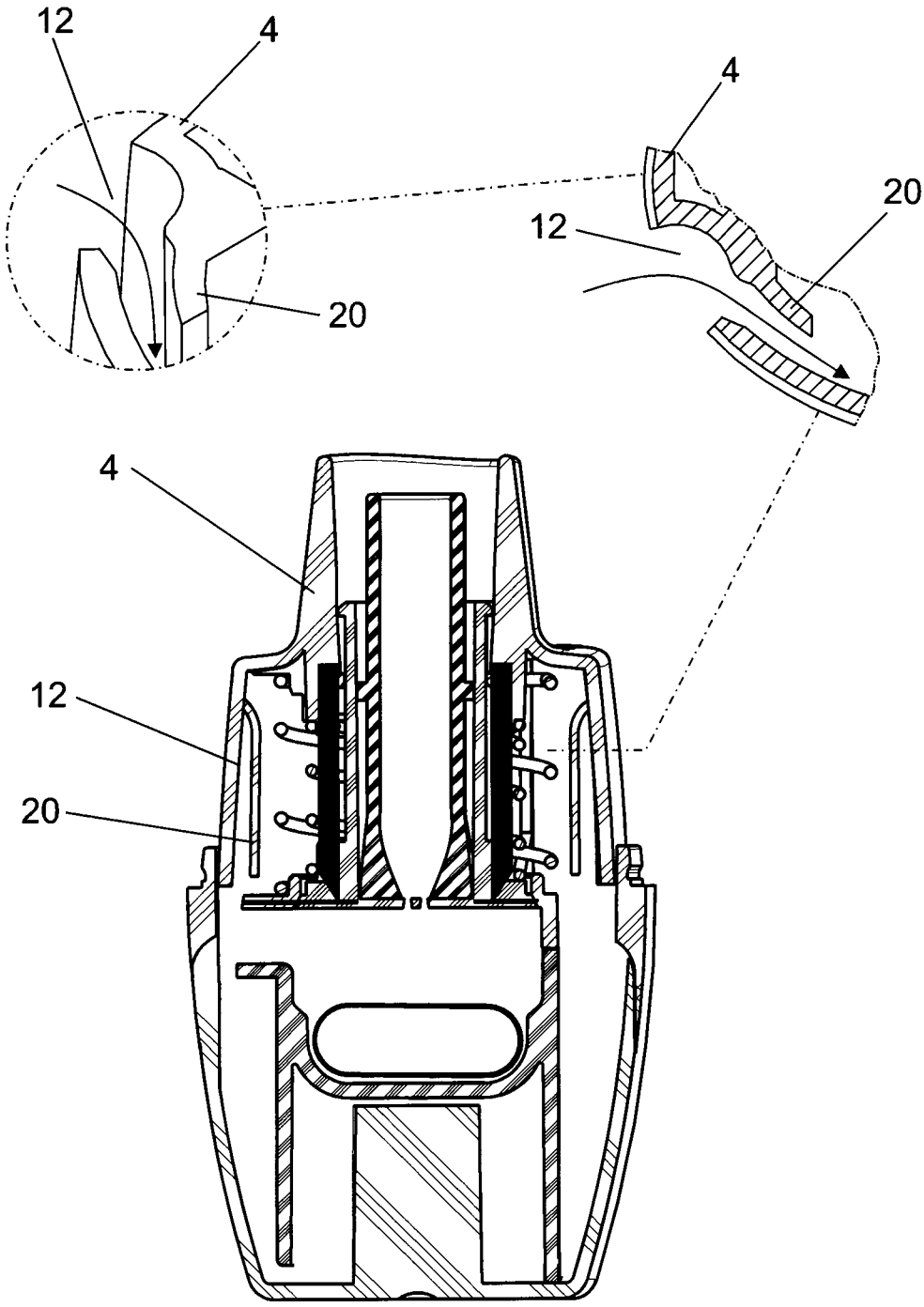


FIG. 14

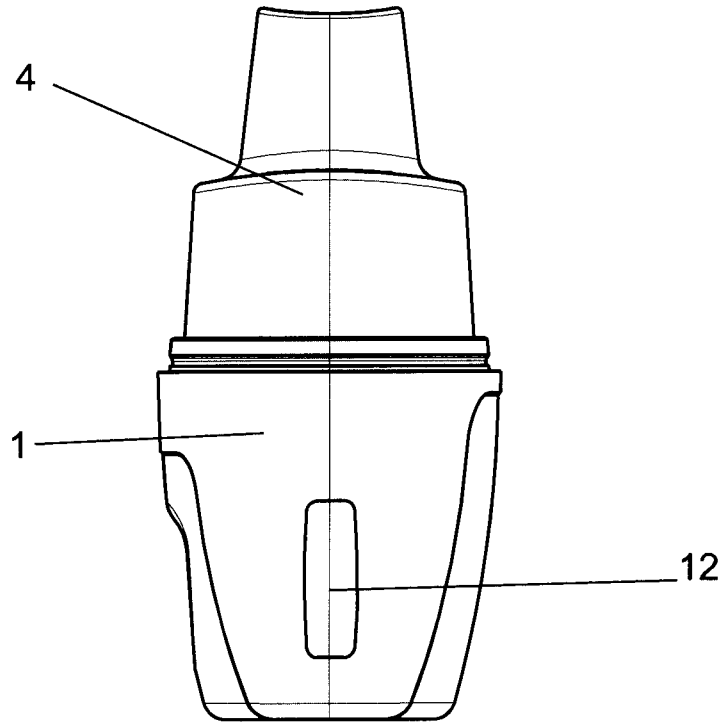


FIG. 15

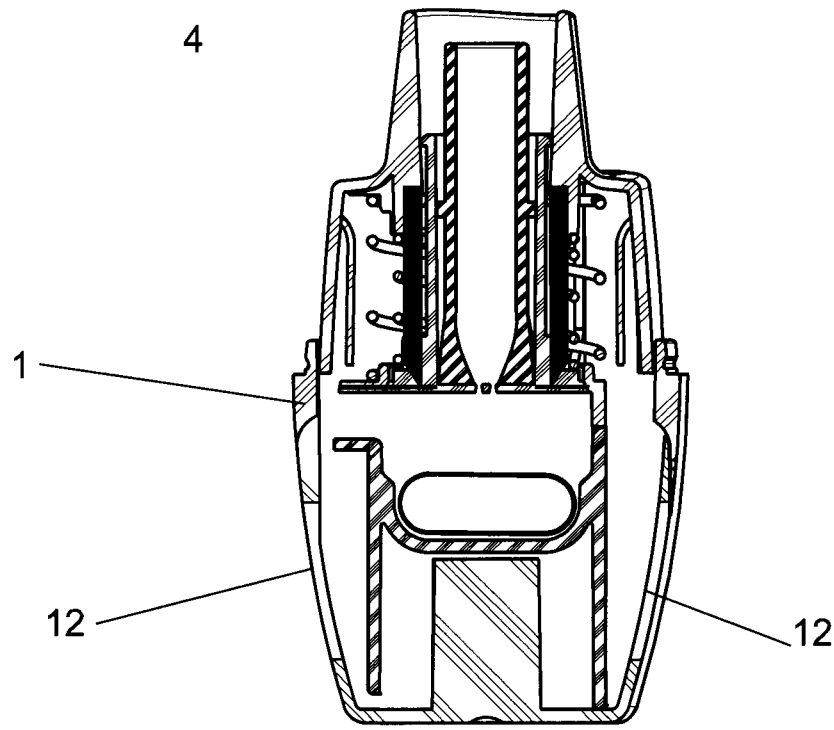


FIG. 16

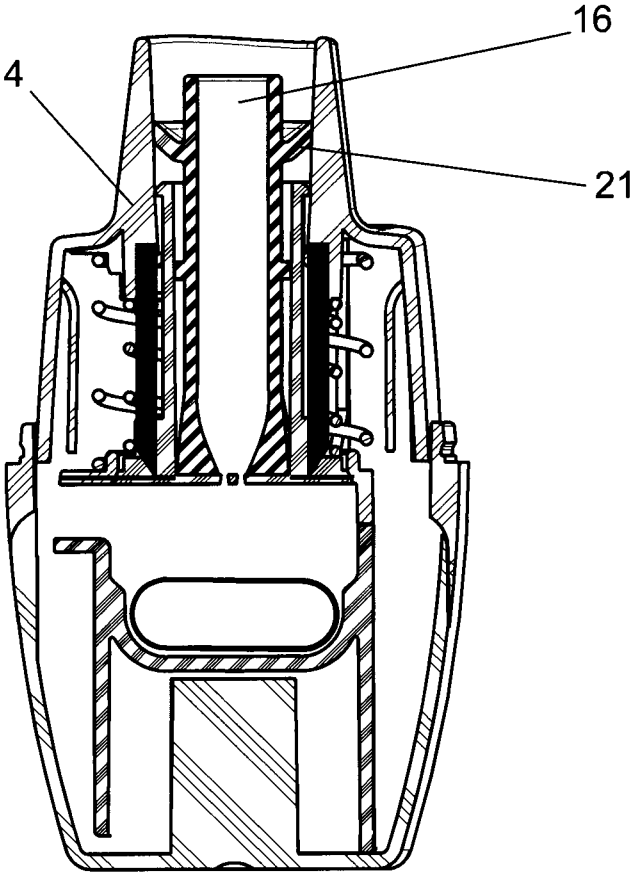


FIG.1 7

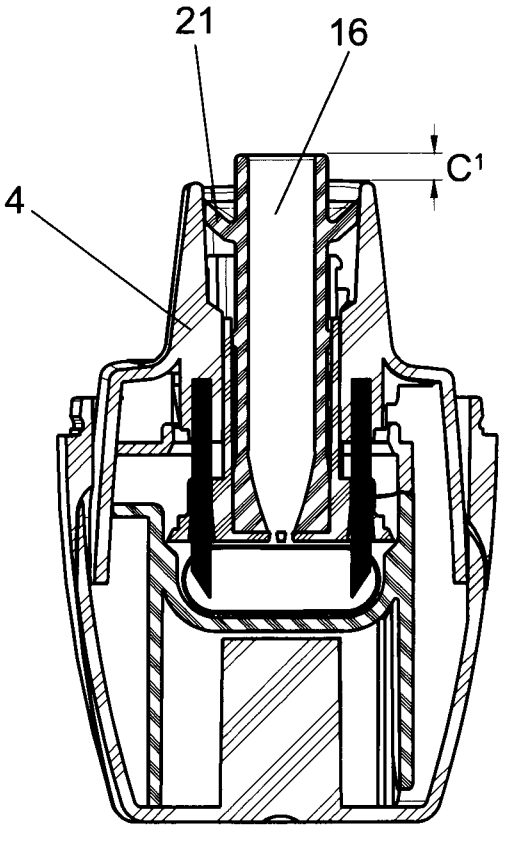


FIG. 18

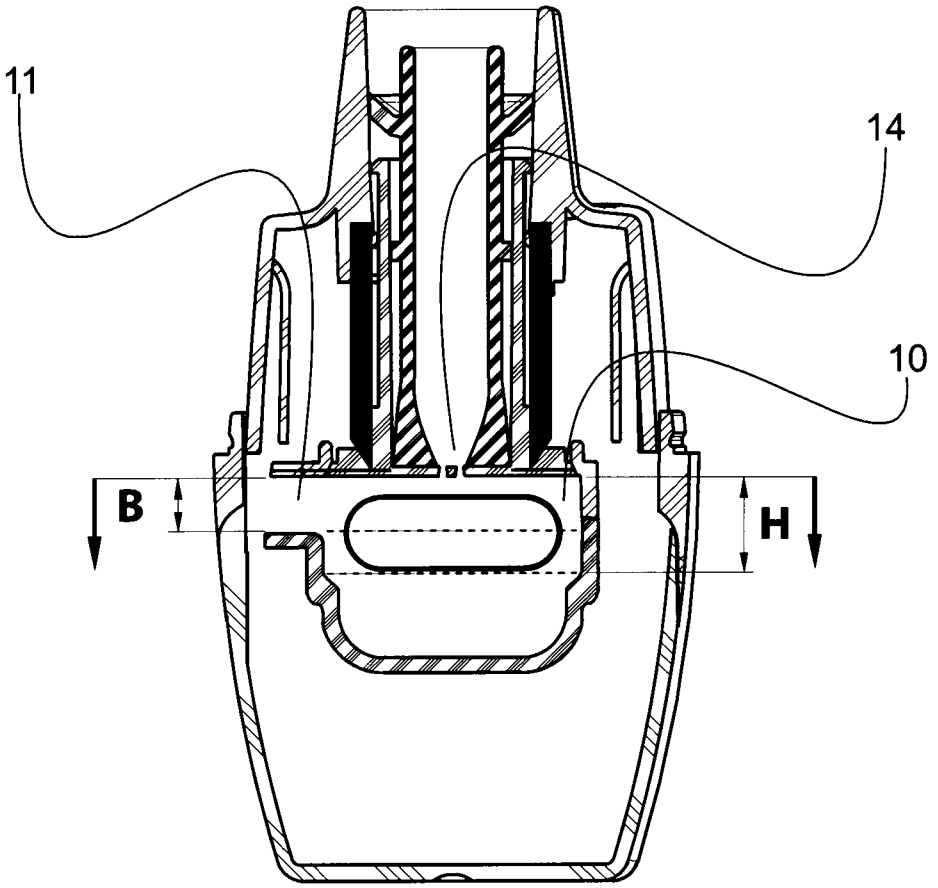


FIG. 19

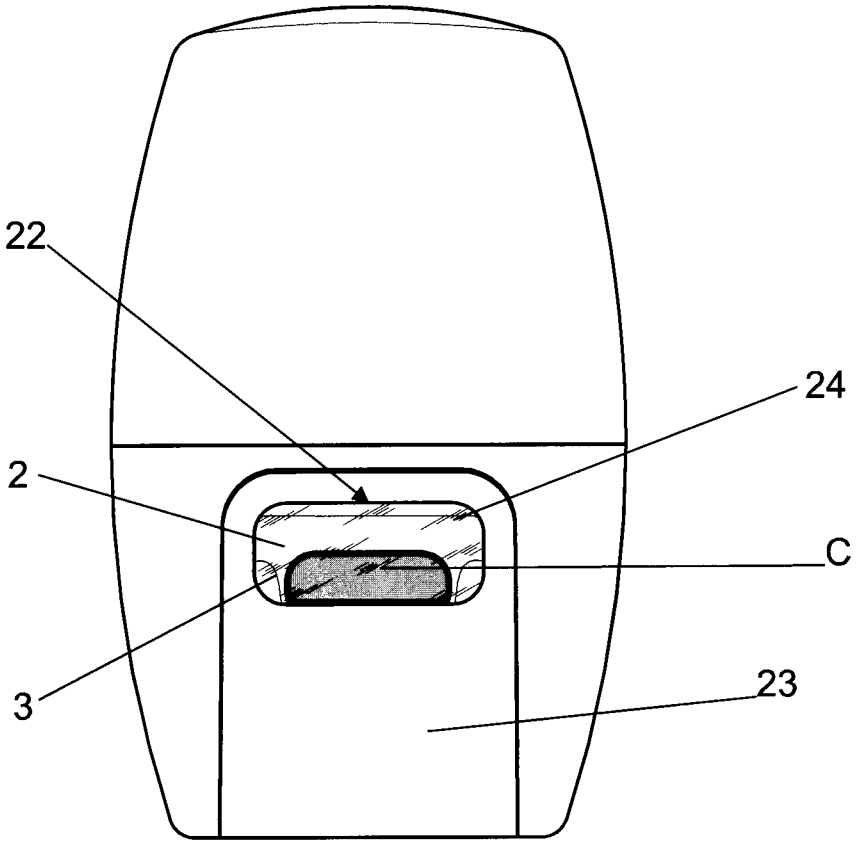


FIG. 20

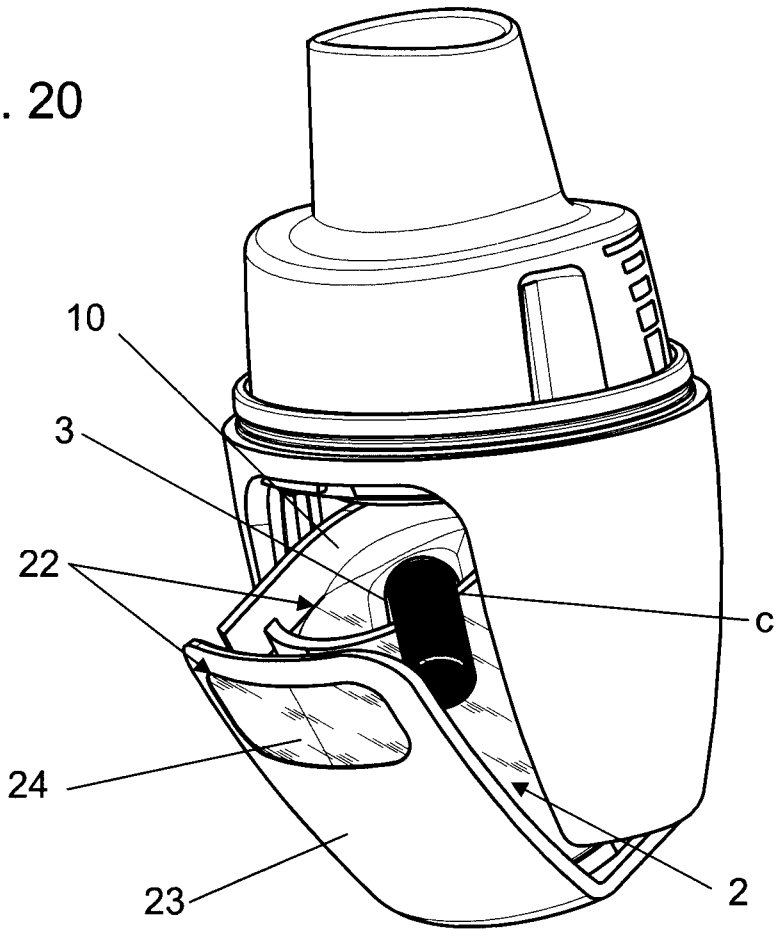


FIG. 21

INTERNATIONAL SEARCH REPORT

International application No
PCT/BR2011/000279

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61M15/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 10 2007 040366 A1 (AHA KUNSTSTOFFTECHNIK GMBH [DE]) 19 February 2009 (2009-02-19) the whole document	1-16
X	WO 2007/098870 A1 (AHA KUNSTSTOFFECHNIK GMBH [DE]; ESLEVE VIKTOR [BR]; KREIM ACHIM [DE] A) 7 September 2007 (2007-09-07) cited in the application the whole document	1-16
A	BR PI0 501 263 A (BIOSINTETICA FARMACEUTICA LTDA [BR]) 28 November 2006 (2006-11-28) cited in the application the whole document	1-16

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 March 2012	11/04/2012

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Azaïzia, Mourad

INTERNATIONAL SEARCH REPORT

International application No
PCT/BR2011/000279

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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